Nitrogen is an element essential to all life processes as it forms amino acids, proteins,核酸 acids, DNA, that are vital for all living organisms. The paper presents the investigation of total available nitrogen, soil texture and their relation in four National Parks of Gujarat. The highest available total nitrogen is found in Gir National Park followed by Velavadar National Park, Vansda National Park and least in Marine National Park. Very strong relationship between soil texture and total available nitrogen is found.

**Key words:** Total Nitrogen, Kjeldahl method, Soil texture, N availability, Nitrogen oxides, Biomass burning, fossil fuel combustion.

**INTRODUCTION**

Nitrogen is essential for all living things and in different forms moves in a dynamic biogeochemical N cycle involving, the atmosphere, oceans, lakes, streams, plants and animals. Nitrogen (N) in soils is found in quite heterogeneous chemical species, although it predominates in the organic form, varying from low molar mass compounds up to complex decomposition-resistant substances (Cantarela and Trivelin, 2001) and it is available to plants only after its mineralization has been completed (Krejovik and Licina, 2003). The organic matter mineralization process plays an important role in the nitrogen cycle; it is responsible for the transformation of organic N present in plant tissues into simple inorganic forms (Franzluebbers et al., 1994).

The content of total nitrogen is generally composed of four fractions: Organically fixed nitrogen (possibly differentiated into easily and slightly soluble) proportion and organically fixed nitrogen is calculated as the difference of total soluble nitrogen minus the three further fractions nitrate, nitrite and ammonium. Soil N amount and constitution of N forms are significant indicators of soil organic matter status (Sabiene N. et al., 2010) and according to (Korsaeth et al., 2002), from 1 to 3 % of the organic N in soil is mineralized during the course of the growing season.

Human activity is also speeding up the release of nitrogen from long-term storage in soils and organic matter (Galloway and Cowling, 2002). Perturbations to the global N cycle have implications that range from terrestrial ecology to atmospheric chemistry and global climate change (Jaffe, 1992; Brady, 1998).

**REVIEW OF THE LITERATURE**

Total Kjeldahl N is defined as the sum of free-ammonia and of organic nitrogen compounds which are converted to (NH₄)₂SO₄ under the conditions of digestion which are specified below (Kammerer et al., 1967). Climate assesses a dominant influence on the distribution of available total nitrogen in soils. Gil-Stores et al. (1993) observed in soils developed from Heirama lignite in North Western Spain that total nitrogen content of the soil increased rapidly with the soil age, mainly in the humic acid fraction. Kaistha et. al. (1990) confirmed that the profiles at higher elevation had higher available total nitrogen than these at lower elevation and its continent varied from 3200 ppm in surface horizon of wet temperate zone to 250 ppm in the sub-surface horizon of humid temperate zone and while nitrogen was significantly correlated with clay content for top soils only. Aggrawal et al. (1990) recorded a consistent trend in the depth-wise distribution pattern of available total nitrogen in different soil profiles and is closely related to organic carbon and thus followed the distribution.
pattern of organic carbon contents of soil. Ganapathi (1991) reported that combined application of organic and inorganic fertilizers increased the organic matter and total N content of the soil, where in there was a substantial increase in the available N content of the soil. Mey-GA-Van-der et al. (1994) noticed a relationship between mineral nitrogen and total nitrogen for different sample depths. Manure fertilization of sandy soils increases while litter manure decreases nitrate leaching as its mineralization is slow (Tripolskaja and Romanovskaja, 2001). The increasing of soil exploitation, intensive farming, soil erosion can lead to increased soil OM mineralization and N loses, reduced soil productivity, as well as polluted surface waters and air with NH3, greenhouse gas N2O (Haag and Kaupenjohann, 2001). Verma et. al. (1980) reported that the available total nitrogen of alluvial soils is positively correlated with the organic carbon present in the same and also mentioned Organic carbon as an index to assess the nitrogen status of the soils. Hence, accurate investigation of soil organic carbon (SOC) and total nitrogen (TN) storage at a regional level is important for detecting changes in the C and N sequestration and emission potentials induced by land-use and cover type changes (Li Y., et al., 2014). Bhatt Megha (2003) and Bhatt Megha (2014) contributed to regional data by estimating terrestrial N cycle by calculating N pools and fluxes in India. Simple model sensitivity studies and a limited number of field measurements can guide the choice of input data values and lead to simulations that reflect the main features of the field soil nitrogen regime. Such an approach provides initial values for a modelling exercise, and improves intuition regarding the relative importance of processes and interactions in the field nitrogen cycle (Hutson and Wagenet, 1991).

Study area

For the estimation of Total Nitrogen the various soil-samples were collected from following four National Parks of Gujarat:

1. Gir National Park
2. Vansda National Park
3. Velavadar National Park
4. Marine National Park

Collection of samples

Random sampling of the soil collection was done using GPS. The GPS points were decided knowing the different-zones in the park. Soil sample cores were taken from altogether 41 sites from different locations of all four National Parks. These cores were taken at one depth 0-30 cm by hand auger in zip-lock plastic bags. The soil samples were air-dried and passed through a 2 mm mesh sieve to remove the stone pieces and large root particles. The numbers of the samples are decided according to the area of the national parks given in National FAO-Data.

METHODOLOGY

For the estimation of Total N from soil, methodology was adopted from (Gupta P.K., 2006) which follows Kjeldahl Method with variation to recover maximum amount of Total N. Methodology for Soil Texture analysis was also adopted from (Gupta P.K., 2006) and for soil texture, spread soil on a newspaper to dry. Remove all rocks, trash, roots, etc. Crush lumps and clods and then follow the methodology.

Calculations for the experiment are as follows

Weight of soil taken = 20.0 g

Volume of 0.02 N H2SO4 required for titration = R ml

Volume of 0.02 N H2SO4 required for blank titration = b ml

Actual volume of 0.02 N H2SO4 used for soil titration = (R – b) ml

Suppose this accrual volume of 0.02 N H2SO4 = x ml

Then, 1000 ml of 1 N H2SO4 = 14 gm Nitrogen (atomic wt. of N is 14)

1 ml of 0.02 N H2SO4 = 14 × 0.02 × 1000 = 0.00028 g Nitrogen

Hence,

x ml of 0.02 N H2SO4 = 0.00028 × x Nitrogen.

Because this nitrogen is present in 20 g soil

\[ \therefore \text{ Nitrogen is present in 20 g soil } = 0.00028 \times x \text{ g} \]

Or

\[ \text{Nitrogen on 0.02 kg soil } = 0.00028 \times x \text{ g} \]

\[ = \frac{0.00028 \times x}{1000} \text{ kg} \]

Weight of 15 cm soil in one hectare = 2.24 × 10^6 kg

\[ \therefore \text{Available Nitrogen in kg/ha} = \frac{0.00028 \times x \times 2.24 \times 1000000}{1000 \times 0.02} \]

\[ = 0.28 \times 112 \times x \text{ kg/ha} \]

\[ = 31.36 \times x \text{ kg/ha} \]

Available N kg/ha = 31.36 × actual volume of H2SO4 used in titration.

In the similar way, for all four National Parks site-wise calculations were done using Microsoft Excel.

RESULTS AND DISCUSSION

The results and graph of (1.) Available Total Nitrogen and (2.) Soil texture of all the four National Parks which describes about both parameters briefly.

Gir National Park

As per the graph site number 2 and 11 shows maximum available total Nitrogen as 34.5 and 25.0 kg/ha respectively.
whereas site numbers 13-19 shows a quite uniformity. The least amount is seen again uniformly in site numbers 3, 4, 5, 6 and 9 as 6.27 kg/ha.

Average % of clay obtained is 0.11 (+ 0.058) followed by average mean% of silt as 0.14 (+ 0.096) and finally average mean % of sand obtained is 0.91 (+ 0.558). In Gir National Park the average % of clay is (P= 0.388040873) i.e. positively correlated with amount of total Nitrogen followed by average % of silt which is (P = 0.331) significantly positively correlated whereas the average % of sand is (P = 0.0832) sparsely positively correlated with the amount of total available Nitrogen of Gir National Park.

Soil texture of Gir National Park

The graph shows that site number 7 shows maximum available total Nitrogen as 37.63 kg/ha whereas site numbers 8 and 9 shows a quite uniformity. The least amount is seen again uniformly in site numbers 1, 3, 4, 11 as 18.816 kg/ha. Average % of clay obtained is 0.09 (+ 0.059) followed by average mean% of silt as 0.19 (+ 0.042) and finally average mean % of sand obtained is 0.72 (+ 0.062). In Marine National Park the average % of clay is (P= 0.255) i.e. positively correlated with amount of total Nitrogen followed by average % of silt which is (P = -0.377) significantly negatively correlated whereas the average % of sand is (P = 0.012) sparsely positively correlated with the amount of total available Nitrogen of Marine National Park.

Marine National Park

As per the graph site number 7 shows maximum available total Nitrogen as 37.63 kg/ha whereas site numbers 8 and 9 shows a quite uniformity. The least amount is seen again uniformly in site numbers 2 as 9.41 kg/ha.

Vansda National Park

The graph shows that site number 3 shows maximum available total Nitrogen as 15.68 kg/ha whereas the least amount is seen in site numbers 2 as 9.41 kg/ha.
Estimates of total nitrogen availability in forest soil types of Gujarat

In Vansda National Park the average % of clay is (P=0.458) i.e. positively correlated with amount of total Nitrogen followed by average % of silt which is (P = -0.454) significantly negatively correlated whereas the average % of sand is (P = 0.155) sparsely positively correlated with the amount of total available Nitrogen of Vansda National Park.

In Velavadar National Park the average % of clay is (P= -0.182) i.e. positively correlated with amount of total Nitrogen followed by average % of silt which is (P = 0.039) and finally average % of sand is (P = 0.041).

Average % of clay obtained is 0.016 (+ 0.017) followed by average mean% of silt as 0.099 (+ 0.039) and finally average mean % of sand obtained is 0.82 (+ 0.043).

In Velavadar National Park the average % of clay is (P= - 0.247) followed by average mean% of silt as 3.136 kg/ha and finally average mean % of sand obtained is 53.31 kg/ha whereas quite similarity was seen in sites 1 and 3 as 18.816 and 15.68 kg/ha. The least amount is seen in site numbers 4 as 3.136kg/ha.

Comparison of all four National Parks

The disruption of soil structure increases mineralization rates in loams and clays more than in sandy soils and that this increase can be used to estimate the fraction of physically protected organic matter. The relative increase in mineralization was much larger in loams and clays than in sandy soils and much

Velavadar National Park

As per the graph site number 5 shows maximum available total Nitrogen as 53.31 kg/ha whereas quite similarity was seen in sites 1 and 3 as 18.816 and 15.68 kg/ha. The least amount is seen in site numbers 4 as 3.136kg/ha.
larger for N than for C (Hassink J., 1992). In accordance, a very strong relation was found between available Total Nitrogen and soil texture according to statistical analysis the strongest relationship was detected between TN and clay.

Normally, red and black soils are medium to high in amount of available total Nitrogen and sandy soil shows presence of less available nitrogen. Thus Gir and Vansda should show highest availability of N but since Vansda does not show relative high amount because of limited small area and also might be because of anthropogenic activities. Inversely, marine national park showed relatively high amount of N availability because of large area and presence of algal blooms. Results are in accordance and are correlated with Bhatt and Banmeru (2014) who estimated Soil microbial biomass carbon content present in soils of national parks of state of Gujarat.

Conclusion and Future scope

Human populations and their use of land have transformed most of the terrestrial biosphere into anthropogenic biomes, causing a variety of novel ecological patterns and processes to emerge (Ellis E.C., 2011). In forest ecosystems, differences in species composition stand age, and soil moisture may uncouple low N supply from N limitation (Chapin et al., 1986). In addition, the non-uniform rooting distribution of trees and the presence of forest floors add spatial complexities to forest N cycles that make it more difficult to estimate N availability in forests than in agro ecosystems (Binkley D. and Hart S.C., 1989)

The amount of N mineralized or immobilized during the decomposition of a crop residue will influence the amount of N available for crop uptake and will ultimately impact N management practices and groundwater quality (Vigil and Kissel, 1991). As the capacity for nitrogen storage in soils declines, nitrate leaching is likely to increase with associated risk to the environment (Schipper L.A. et al., 2004). N fertilization practices and proper soil management should be used to help optimize natural growth of plants in the forest, N use efficiency, and water quality. At the same time, improved N management practices in case of forest as well as agricultural ecosystems and alternative cropping systems in agriculture could greatly aid in this challenging task.

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Bibliography


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